State of California Department of Transportation Structure Hydraulics

DIVISION OF STRUCTURES FINAL HYDRAULIC REPORT

Russian River

Located near the town of Geyserville
on State Route 128 over the Russian River in Sonoma County

JOB:
Bridge No. 20-0038 – Emergency Bridge Replacement

LOCATION:
04-Son-128-5.44 PM

WRITTEN BY:	DATE:
Sharon Ropp	February 27, 2006
REVIEWED BY:	DATE:
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Hydrology/Hydraulics Report

General:

It is proposed to replace the Russian River Bridge (Br. No. 20-0038), which sustained major damage during a storm event in January 2006. The Russian River Bridge is located near the town of Geyserville, on Route 128. The bridge is currently closed for safety and will be replaced as soon as a new design can be completed and implemented on an emergency contract. According to the preliminary design dated February 23, 2006, the new bridge will be 298.678 meters long. It will be a 10 span reinforced concrete structure built on cast-in-steel-shell (CISS) pile extensions and it will be constructed along the existing alignment. The new structure will be 15.265 meters wide and will have two 3.6 meter lanes, each with 2.44 meter shoulders, and will also have a 1.525 meter wide pedestrian walkway.

The existing structure was built in 1932 and widened with a pedestrian walkway in 1972. The bridge consists of 21 spans. There are 6 spans, which are riveted steel pony truss spans on RC columns with curtain wall piers. The 4 western approach spans and the 11 eastern approach spans are T beam on RC column bents and angle wing abutments. All are on timber piles with unknown depth and soil type.[i]

Basin:

The Russian River begins at approximately 838.2 meters elevation in the Laughlin Range, south of the town of Willits. It flows south into the Redwood Valley where it runs along the base of the Mayacmas Mountains into the Yokaya Valley. The waterway then flows in the Alexander Valley, which is where the bridge is located. The elevation of the Russian River at the bridge is approximately 58 meters. Downstream of the structure, the river flows through the Coast Range where it feeds into the Pacific Ocean near the town of Jenner. The bridge site is approximately at the center of the 193 kilometer Russian River Reach.[ii]

Discharge:

The design 50-year and 100-year discharges for the proposed bridge are approximately 2040 cubic meters per second and 2265 cubic meters per second, respectively. These discharges were obtained from the FEMA Flood Insurance Study, Sonoma County.[iii]

Velocity:

The average main channel velocity for the 100 year discharge is estimated to be 2.0 meters per second. This is based on a Mannings roughness coefficient of 0.040 in the channel. Channel slope of 0.0014 was used. The Mannings roughness coefficient and channel slope were obtained from site visits and topographic maps.

Stage:

The 50-year and 100-year discharges were modeled through the existing bridge site using the US Army Corps of Engineers HEC RAS Version 3.1.2 hydraulic modeling program. The flood stage elevations are approximately 64.23 meters and 64.44 meters respectively. These numbers were calculated based on the survey information that was provided by the district. Structures Hydraulics recommends the minimum soffit elevation to be at 64.7 meters.

This channel was modeled using the HEC RAS program with the new bridge in the channel and compared to a model with no bridge in the channel. The findings were that the bridge affects the backwater in the channel only minimally. The backwater increase was an insignificant amount.

Scour:

The existing bridge is considered to be on an unknown foundation. It is known that the structure is on timber piles but as-built data doesn't specify the pile tip elevations. The channel has had a history of meandering in this area and in 1979 the Army Corps of Engineers placed tetrahedrons in the channel on the upstream west side and a guide bank adjacent to Abutment 1. This was intended to guide the channel to the east, through the bridge main spans. Eventually the tetrahedrons failed and the channel continued to erode the upstream west bank. Also, there have been previous attempts to place rock slope protection (RSP) around the piers to mitigate the presence of scour holes. All attempts to train the river flow have failed.

Under the current channel conditions the projected local pier scour for the structure during a 100 year storm event is estimated to be between 3.6 and 8 meters deep – see table below. These scour depths and elevations are based on the column configurations shown in the table. All columns are assumed to be cast-in-steel-shell (CISS) type. No contraction scour is anticipated. Predicted degradation in the channel is approximately 3 meters. The channel is predicted to migrate between proposed pier 7 and abutment 1, and could possibly migrate further west beyond abutment 1.

The following table identifies the scour depths and associated elevations at the proposed pier locations and includes potential degradation. These elevations are based on the channel cross section that is dated January 10, 2006.

Scour (cont):

SCOUR SUMMARY				
	Column Configuration	Pier Scour Depth (Meters)	Pier Scour Elevation (Meters)	Pier Scour Elevation – Including Degradation (Meters)
Abut 1	Single Row of 3 Columns 1.524m Diameter ea	3.6	52.03	49.03
Pier 2, Pier 3, Pier 4, Pier 5, Pier 6 & Pier 7	Single Row of 2 Columns 1.524m Diameter ea	3.6	52.03	49.03
Pier 8, Pier 9, Pier 10, & Abut 11	Two Rows of 7 Columns .61m Diameter ea	8.0	53.62	50.62

Debris:

Field observations, photographs and past Bridge Inspection Reports indicate that the site is susceptible to medium to large sized drift. The new bridge will have fewer piers than the existing bridge but the spacing of the piers in the waterway will be the same as the existing. The proposed design of pier 2 through pier 7, which have two round columns in the waterway, will help to mitigate past debris issues. The proposed design of pier 8 through pier 10, which are designed as a grouping of 14 piles, will potentially catch floating debris during high flows. Debris accumulation was considered in the scour depth calculations at piers 8 through 10.

Streambed:

According to the channel borings that were taken in February 2006, the sediments encountered under the existing bridge consisted predominately of inter-bedded fine to coarse gravel, sandy gravel, medium to very coarse gravelly sand and sand. These deposits were mainly loose to medium dense to a depth of approximately 6.1 meters below the channel surface. Below that depth they were mostly dense to very dense to the maximum depth of approximately 54.8 meters below the channel surface. There was an exception to these findings at the most easterly boring located near proposed pier 10. At that location between depths of 19.8 to 29.0 meters a 9.1 meter bed of still lean clay was encountered. Also, the adjacent boring, which is located near proposed pier 8, there was a .61 meter layer of lean clay encountered at approximately 22.9 meters deep. Based on these findings, clay deposits most likely will be present under proposed piers 8 through 10 and Abutment 11 and not likely to be present under Abutment 1 or proposed piers 2 through 7.

The stream channel is relatively clear of vegetation. The banks upstream and downstream of the structure are vegetated with grasses, shrubs, vines and trees. There are gravel bars in the channel upstream and downstream of the structure.

Summary Information for Designers:

HYDROLOGIC/HYDRAULIC SUMMARY			
Drainage Area: 1694 km^2			
	Design Flood	Base Flood	Overtopping Flood
Frequency (yrs)	50	100	>500
Discharge (m^3/s)	2040	2265	
Water Surface Elevation with New Bridge Waterway Area (m)	64.23	64.44	66.02
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. **The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation. Addendums may be necessary as Foundation Reports are completed.**			

Proposed Bridge Length	298.7 m
Minimum Soffit Elevation	64.7 m
Potential Scour Elevation at Abutment 1 & Piers 2 - 7	52.03 m
Potential Scour Elevation at Piers 8 - 10 & Abutment 11	53.62 m
Average Upstream Velocity	2.0 m/s

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

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REGISTERED CIVIL ENGINEER SIGNATURE

REGISTRATION NUMBER:_____ DATE:_____

References:

[i] Bridge Inspection Report Br. No. 20-0038, January 10, 2006.
[ii] Area USGS quadrangle maps were used in determining the basin information.
[iii] FEMA Flood Insurance Study - Sonoma County, California. Unincorporated Areas. Volume I, II & III Revised: June 19, 1997
[iv] All elevations given are based on the NAVD 88 datum.